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Physical and Biological Monitoring at Prince 5 during 1999

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Abstract

This is a preliminary summary of the physical and biological monitoring conducted at Prince 5 in 1999. The sampling effort is described along with preliminary results. At the time of preparation, analyses of all phytoplankton and zooplankton and some nutrient and chlorophyll samples had not been completed. As the data become more fully analyzed and quality controlled some of the results from this analyses may change.

Résumé

Ce document présente un sommaire préliminaire des études d'observation des éléments physiques et biologiques faites à Prince 5 en 1999, dans lequel sont décrits les travaux d'échantillonnage ainsi que les résultats préliminaires. Au moment de préparer ce sommaire, les analyses visant à établir les concentrations de phytoplancton, de zooplancton, de nutriants et de chlorophylle n'étaient pas terminées pour l'ensemble des échantillons. Certains résultats peuvent changer avec une analyse plus approfondie et le contrôle de la qualité des données.

Introduction

This is a preliminary summary of the physical and biological monitoring conducted at Prince 5 (Fig. 1) in 1999. The sampling effort is described along with preliminary results. At the time of preparation, analyses of all phytoplankton and zooplankton and some nutrient and chlorophyll samples had not been completed. As the data become more fully analyzed and quality controlled some of the results from this analyses may change.

Methods

Efforts are made to sample Prince 5 throughout the year at approximately two week intervals. However, due to conflicts in ships schedules and weather this is not always achieved.

The intended sampling during each visit to Prince 5 consisted of:

- a CTD profile that included sensors for conductivity, temperature, pressure, oxygen, fluorometery and optical backscatter,
- water bottle samples for nutrient and plant pigment analyses,
- water bottle samples for phytoplankton,
- net tows for zooplankton, and
- a Secchi depth reading.

For most of the sampling trips the CCG RV *Pandalus III* was used. When the *Pandalus* was not available, the HMSC *Scott* was used. The sampling that was achieved in 1999 is summarized in Figure 2.

CTD and Calibration Sampling

The CTD sampling follows the traditional hydrographic sampling that has been in place since the early 1920s. In 1999, a Seabird Sealogger CTD (Model 25) outfitted with a pump, YSI oxygen probe, WetStar flourometer and a SeaPoint Turbidity meter (OBS sensor) was attached to the end of hydrographic wire. A 1m line with a heavy weight was attached to the bottom of the CTD cage to help prevent the CTD from being lowered into the bottom. The CTD was lowered at a rate of approximately 1m every 3 seconds (100m in 5minutes). When this instrument was not available, a SeaBird Seacat Profiler (Model 19) outfitted with a WetStar flourometer was used.

Surface and bottom salinity samples were collected in clean and labeled 200ml glass salinity bottles for each depth. The samples were transported back to the lab and analyzed using a Guildline Model 8400 Autosal. The results were compared to those collected by the CTD.

An Orion Model 840 Dissolved Oxygen probe was used for measurements of dissolved oxygen at 10m with the salinity value set to 30. Initially, the probe was placed inside the

top of the water bottle and a measurement for temperature, DOmg/l, DO %sat was recorded. The method was changed later on in the year. The revised sampling consisted of adding weights to the protective covering of the Orion probe and lowering the probe to a depth of 1m. An in situ measurement was then made for temperature, DO mg/l, DO percent saturation. The values were recorded on field sheets.

Nutrient and Plant Pigment Sampling and Analyses

Much of the water bottle sampling began in the spring-summer of 1999. Sampling protocols evolved throughout the year as experience was gained and zonal protocols were developed.

In 1999, water samples for nutrients and plant pigments were collected at 5 depths: near surface (0m), 10, 25, 50, and near bottom (90-100m). A Niskin bottle was attached to a hydrographic wire so that it was about 1m above the CTD attached to the end of the wire. The bottle and CTD were lowered to approximately 1-2m above bottom and the bottle was triggered using a brass messenger. The sampling gear was brought back to the surface, the CTD turned off and water samples taken from the bottle. The bottle was then drained and the procedure repeated bottle for each of the remaining sample depths. The surface sample was taken with a bucket. Each sample bottle was tagged with a depth-specific six digit label.

Duplicate nutrient samples from each depth were collected in pre-washed 30 ml Nalgene HDPE bottles. The bottles and caps were rinsed 3 times with sample water. Finger contamination of the inside of the bottles was avoided. The bottles were filled to the neck and then placed upright in a freezer on board the research vessel. The samples were sent to BIO for analysis on a periodic basis.

Samples for plant pigment analyses were collected in a clean, brown HDPE 1L bottle rinsed with sample seawater. Each sample consisted of 400-500 ml of water drawn from the water bottle. All samples were kept in a cooler full of ice to keep them from direct sunlight and warmer temperatures until the sample could be filtered. Three 100ml samples (for each sampling depth) were filtered using vacuum filtration onto a 25mm GF75 grade borosilicate microfiber filter immediately after sampling the entire water column. Only in the case of rough seas was there any hesitation to filter. The filters were folded and placed in identically labeled scintillation vials. The scintillation vials were then placed in the on board freezer. Back in the lab, 10 ml of 90% acetone was added to each scintillation vial. The samples were then stored in a flammable substance freezer until they were could be transported to BIO for chlorophyll-a extraction. Transportation of a batch of samples occurred on a periodic/irregular basis.

Secchi Depth

A Secchi disk was lowered over the side of the vessel to the maximum depth where the disk could still be visually detected. This depth was recorded on field sheets.

Phytoplankton

A 250 ml water sample from each water bottle was collected in a rinsed and labeled 500ml HDPE bottle. A 5ml aliquot of a 1:1 mix of formalin and glacial acetic acid was used to fix the sample. The samples were transported back to the lab and sent to BIO for microscopic identification.

Zooplankton

As with nutrient samples some of the net sampling began in the spring-summer of 1999 and sampling protocols evolved throughout the year as experience was gained and zonal protocols were developed.

In 1999, vertical net tows were done when weather permitted. A weight was attached to the cod end of each net. The net was equipped with a flow meter which was reset after the reading was recorded , and before the next deployment. Net tows were made with three mesh sizes during 1999. Tows taken with a 333 micron mesh net were hauled through the entire water column whereas the 202 and 76 micron tows were only hauled through the top 50 meters of the column. This will be changing as of February 2000 and tows of the entire water column will be done. The 333 micron tows were conducted as part of another project and will not be continued throughout the year 2000.

After each tow the contents of the net were washed carefully into a 1L glass jar with a teflon liner inside the cap. The sample was preserved with 100ml of buffered formalin. A waterproof label with station, date, depth, tow and collection information was placed in all jars. The samples were brought back to the lab. Periodically, the 202 and 76 micron samples were sent to BIO to be analysed as outlined in the Atlantic Zone Monitoring Program (AZMP) Sampling Protocol. The 333 micron samples were taken to the Atlantic Reference Center (ARC) for sorting, identification and enumeration.

Results

Temperature and Salinity

Temperature, salinity and density at Prince 5 undergos a pronounced seasonal cycle. In 1999 the temperature varied from less than 2.6°C in March to 13.5°C in September (Fig. 3 & 6). The temperature range within each profile varied from 0.1°C to 2.9°C, with the greatest ranges occurring during the summer months. Except for the mid-January sample, all temperatures were above the 1961-90 means for 0,10,25,50,75 and 90m depth (Fig. 6).

Salinities varied from 30.2psu in April to 33.4 psu in November (Fig. 4 & 7). For the most part the salinity range within a profile was fairly constant at about 0.5psu. Annual minima in the range occurred in January and June (0.01& 0.08psu) and maxima (1.8 & 1.6psu) in April and December. These salinities were below the 1961 to 1990 means from

January until April-May and above the climatological means from May through December (Fig. 7).

These temperature and salinity characteristics resulted in the water column being stratified for much of the year. With few exceptions, the range in density within each profile varied from about 0.5-1.0 sigma-t units from February through October (Fig. 5). The exceptions included a strong peak in stratification during April (day 119) that corresponded with a salinity minimum and an apparent loss of stratification in June (day 165) that corresponds with the lack of CTD data from the upper 20m of the water column. The water column was well-mixed during January and November-December, with the exception of brief stratification in December.

The individual depth profiles of temperature, salinity and density (sigma-t) are shown in Figures 8,9&10.

Secchi Depth and Optical Backscatter

The Secchi depths ranged from about 4 to 7m and showed no strong seasonal trend (Fig. 11).

Turbidity profiles were only collected for the latter part of the year. During this time the data give no indication of a seasonal pattern (Fig. 12). The vertical profiles of turbidity indicate little seasonal variation near the surface and suggest enhanced turbidity near the bottom between days 216 and 270 (Fig. 13).

Pigments

The concentration of plant pigment as indicated by the WetStar Flourescence sensor undergoes a seasonal cycle with consistently low values in winter and late fall and considerably higher values in the spring and summer (Fig. 14). The depth profiles indicate the pigments are vertically well mixed during the winter and late fall (Fig. 15). The higher values observed the spring and summer are the result of elevated values in the upper few tens of meters of the water column (Fig. 15). A shallow sub-surface chlorophyll maxima is indicated in some profiles (Fig. 15).

A comparison of the WetStar values with the values of extracted pigments (chlorophyll and phaeophytin) has not been completed. Preliminary comparisons made with the data from available extractions, indicate there is not a tight relationship between the two. However, this may be due in part to changes in the sampling protocols. A more thorough comparision will be made when all pigment extraction data is available.

Nutrients

Although all nutrient water samples have not been analysed yet, the data to date indicates some seasonal variation. The concentration of silicon (SIO) is relatively high in the winter and fall and low in the summer (Fig. 16). A somewhat similar pattern exists for

phosphorous (PO4) and perhaps nitrogen (NO2&NO3), although the latter is not so clear (Fig. 16). The concentrations throughout the year are largely independent of depth (not shown).

Phytoplankton

At the time of preparation of this document, the phytoplankton samples had not been analysed.

Zooplankton

At the time of preparation of this document, the zooplankton samples had not been analysed.

Variation over a Tidal Cycle

The Prince 5 station is located in an area of strong tidal currents and large tidal excursions. Hence, the water at Prince 5 can potentially be from the inshore Head Harbour Passage area, which is the main flow pathway for the fresh water from the St. Croix River system, or the more offshore Grand Manan Channel area (Fig. 1). The characteristics of the water measured at any particular time may therefore be a function of the phase of the tide at the time of sampling. As an initial effort to help quantify this possibility a time series of CTD, nutrient and plankton samples was taken at Prince 5 on August 4, 1999 from 10:55 GMT to 17:56 GMT.

The composite depth profiles of temperature and salinity (Fig. 7) indicate that at this time of year, at least in this particular year, temperature varies by about 0.5°C and salinity by about 0.1psu over the tidal cycle (Table 1). This suggests that monthly deviations of this magnitude from long-term means should be interpreted cautiously.

Table 1: Temperature and salinity ranges at selected depths estimated from the time series of profiles taken at Prince 5 on 4 August 1999 from 10:55am to 1756pm.

Depth below the surface (m)	Temperature Range (deg. C)	Salinity Range (psu)
-1	0.6	0.04
-5	0.3	0.02
-10	0.5	0.12
-15	0.4	0.09
-20	0.4	0.10
-30	0.4	0.06
-50	0.6	0.17
-75	1.3	0.35
-80	1.3	0.38

The individual depth profiles of temperature and salinity are shown in Figures 18 and 19. The data from the plankton and nutrient samples has not been examined as yet, since the samples have not all been processed.

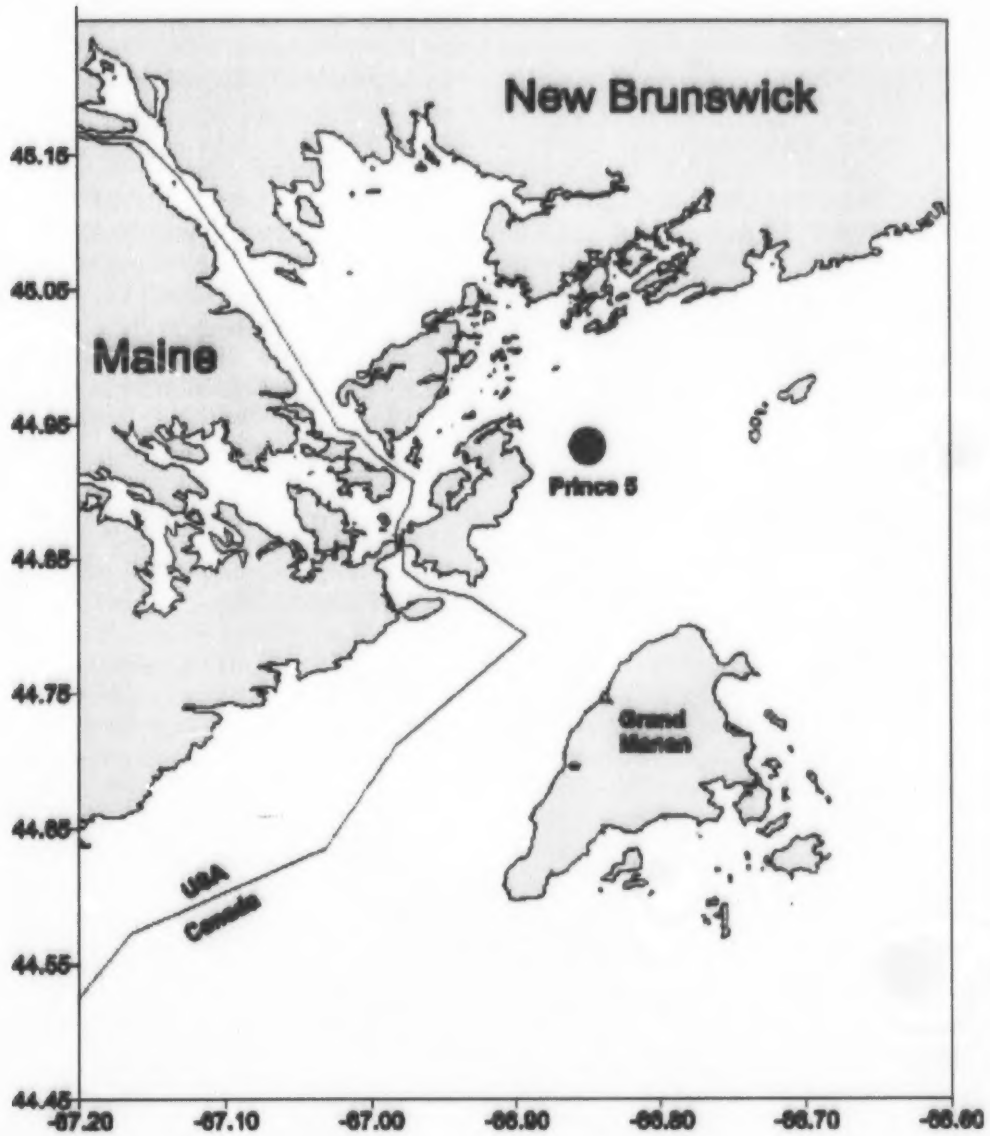

Figure 1: Map showing the location of the Prince 5 sampling station.

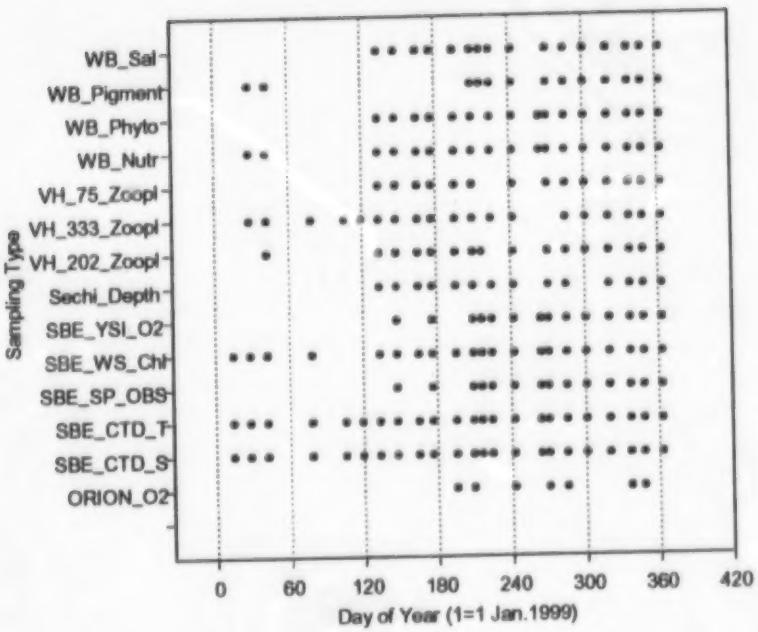

Figure 2: Sampling effort conducted at Prince 5 during 1999.

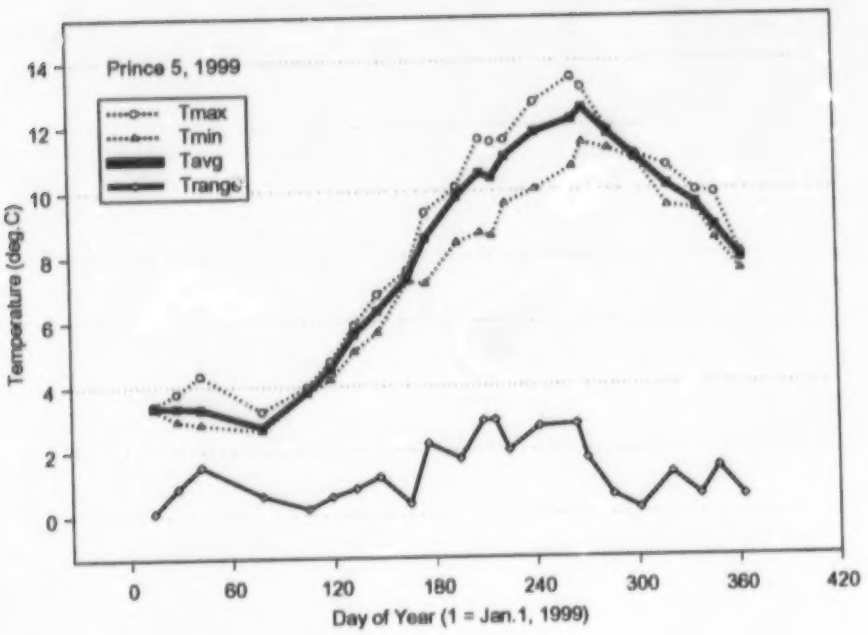

Figure 3: Annual time series of profile minimum, average, maximum and range of temperature at Prince 5 in 1999.

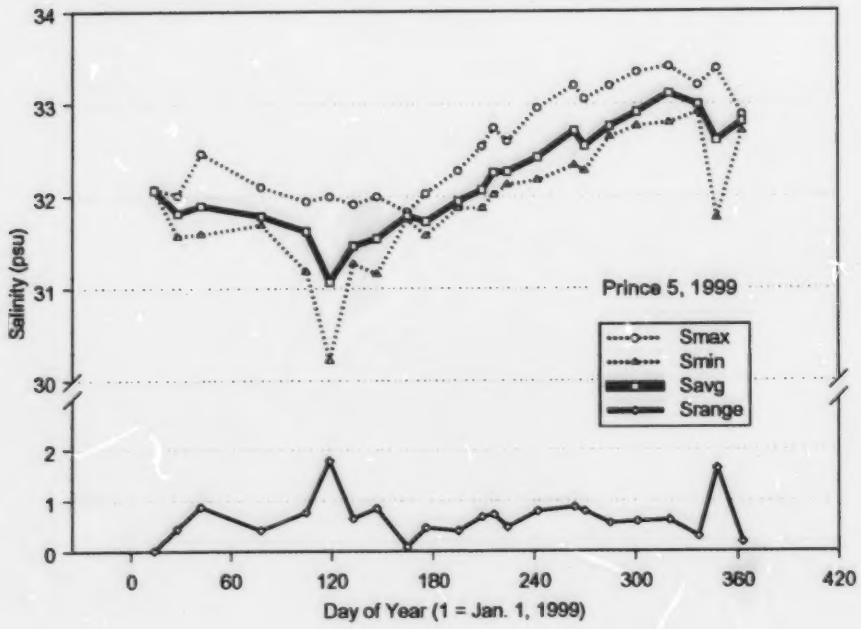

Figure 4: Annual time series of profile minimum, average, maximum and range of salinity at Prince 5 in 1999.

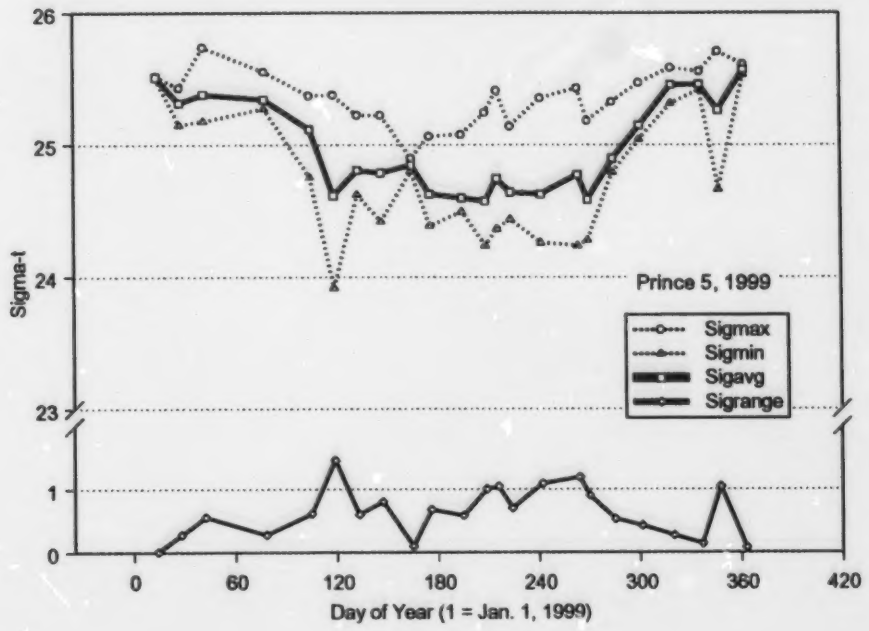

Figure 5: Annual time series of profile minimum, average, maximum and range of density (sigma-t) at Prince 5 in 1999.

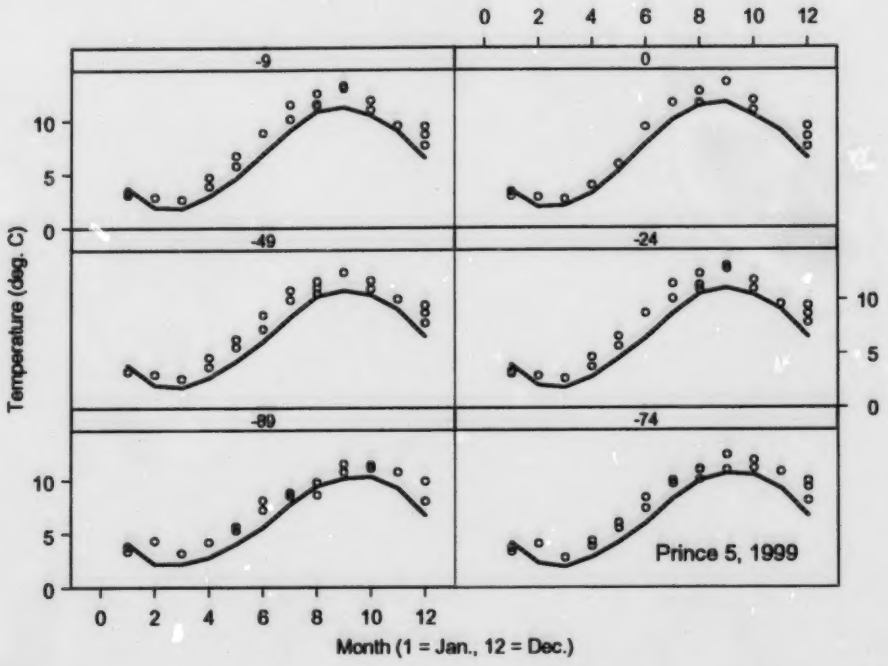

Figure 6: Time series of 1999 Prince 5 temperatures in comparison to the 1961 to 1990 monthly means at depths of 0, 10, 25, 50, 75 and 90m depth.

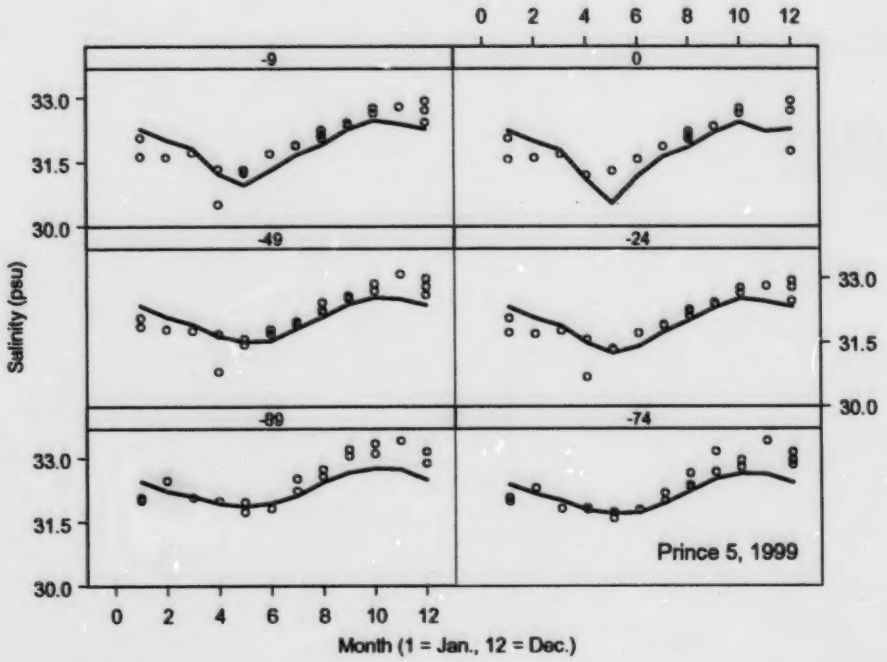

Figure 7: Time series of 1999 Prince 5 salinities in comparison to the 1961 to 1990 monthly means at depths of 0, 10, 25, 50, 75 and 90m depth.

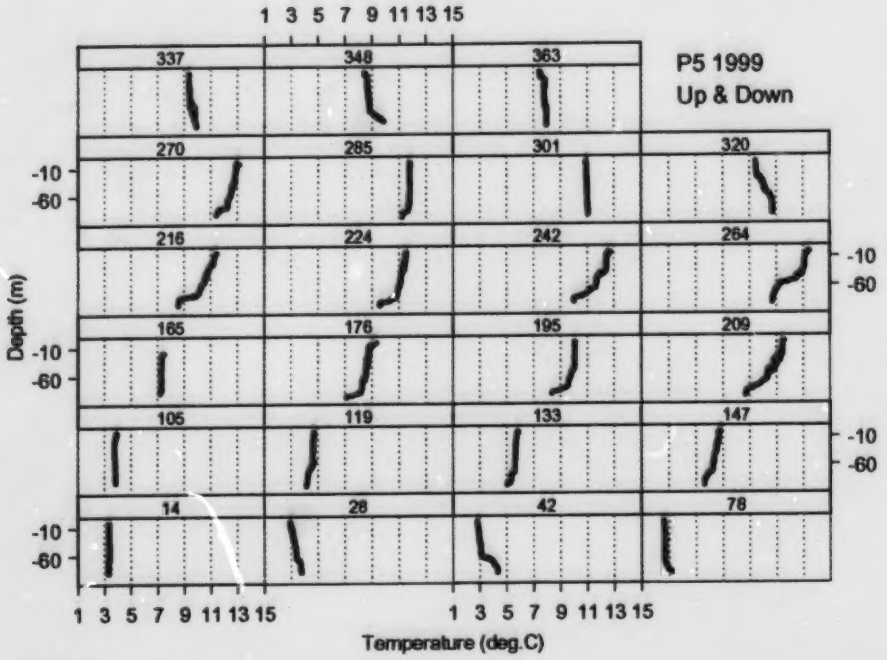

Figure 8: Depth profiles of temperature at each 1999 Prince 5 sampling date.

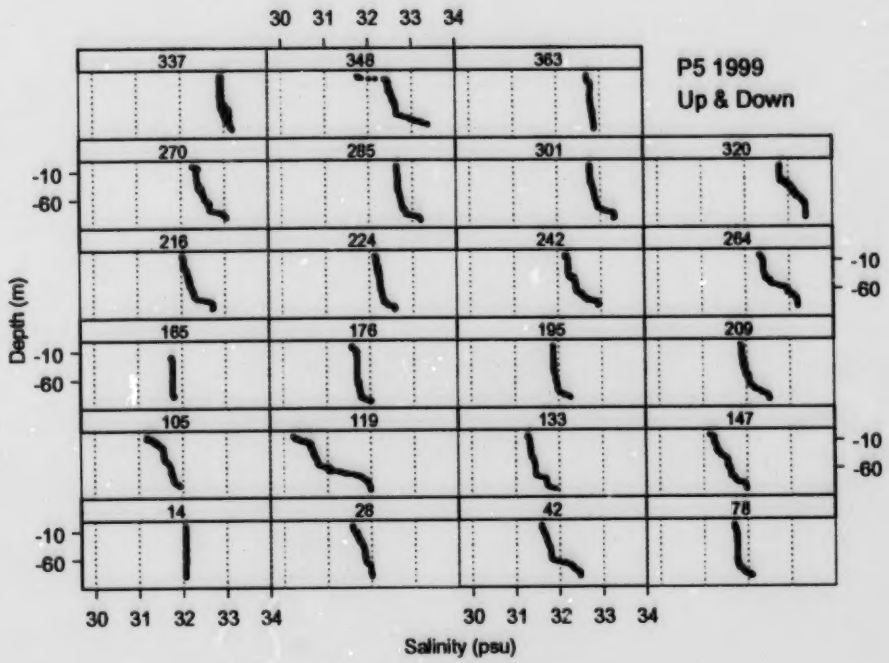

Figure 9: Depth profiles of salinity at each 1999 Prince 5 sampling date.

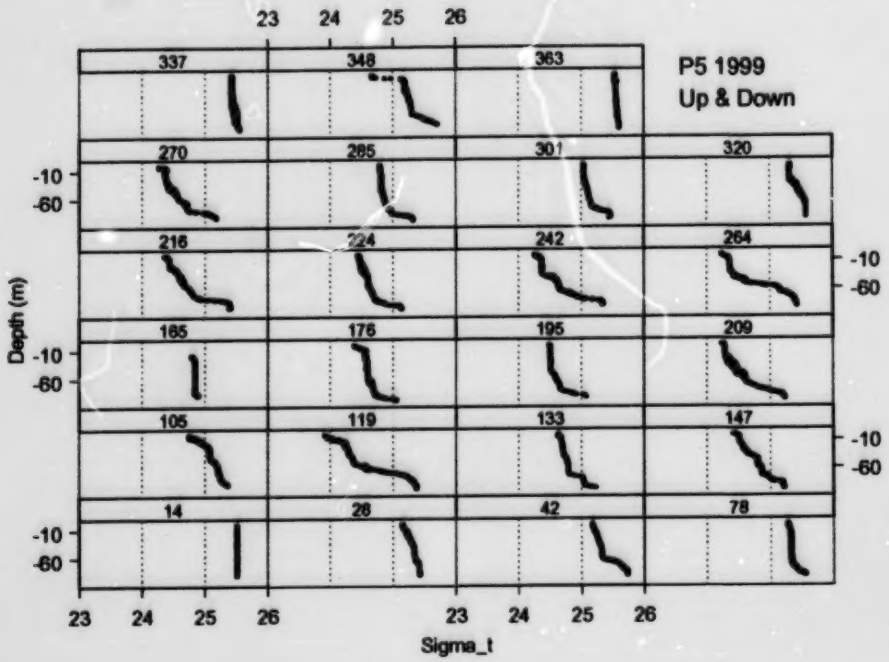

Figure 10: Depth profiles of sigma-t at each 1999 Prince 5 sampling date.

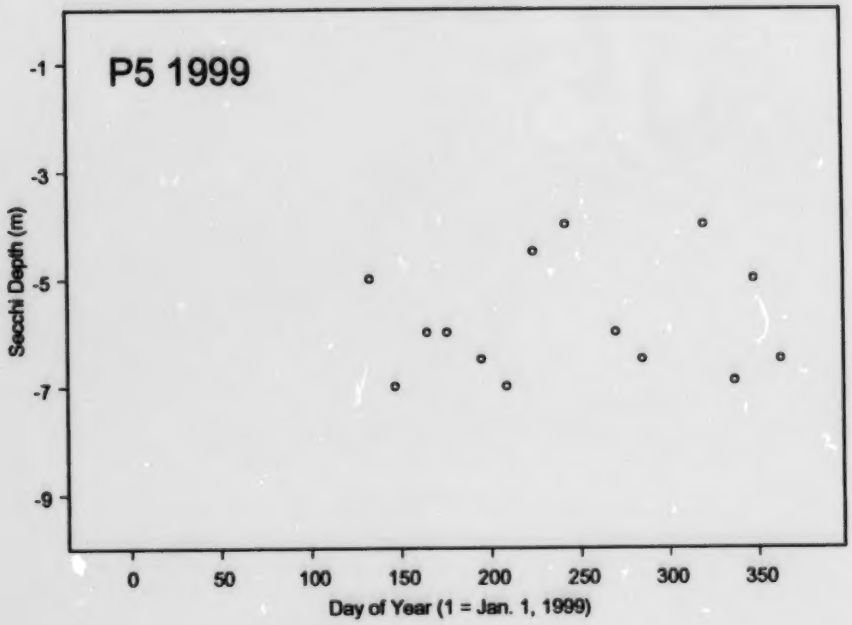

Figure 11: Annual time series of Secchi depths at Princce 5 in 1999.

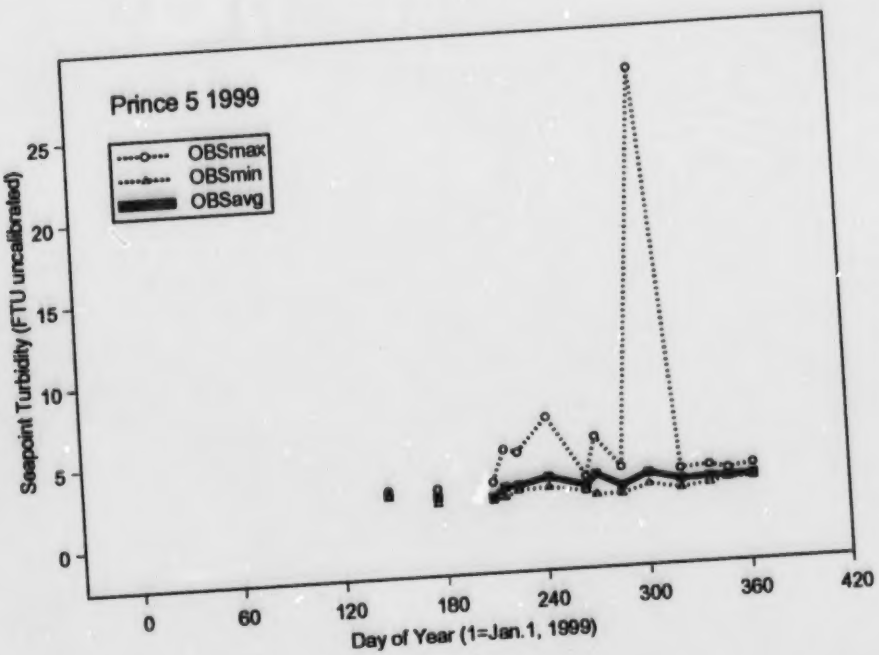

Figure 12: Annual time series of profile minima, maxima and mean Seapoint Turbidity (FTU) concentrations at Prince 5 in 1999.

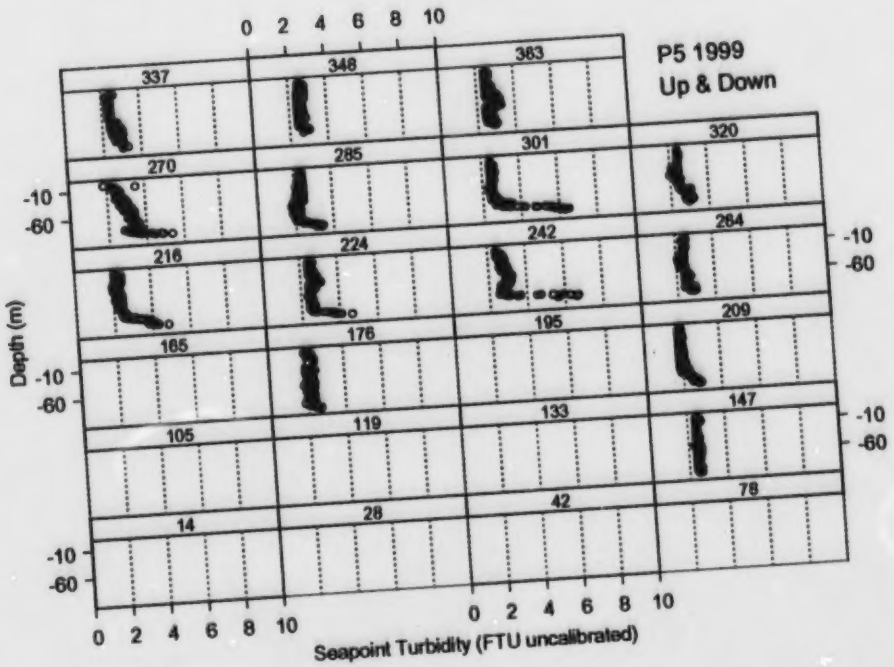

Figure 13: Depth profiles of uncalibrated Seapoint Turbidity (FTU) for each 1999 Prince 5 sample date. Numbers in the panel above each profile refer to the day of year the profile was taken.

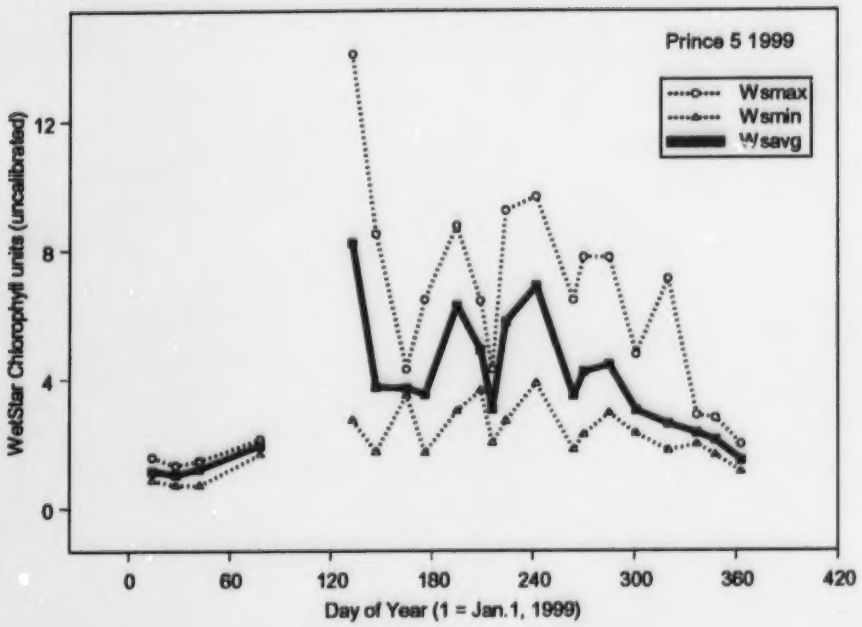

Figure 14: Annual time series of profile minima, maxima and mean WetStar Chlorophyll concentrations at Prince 5 in 1999.

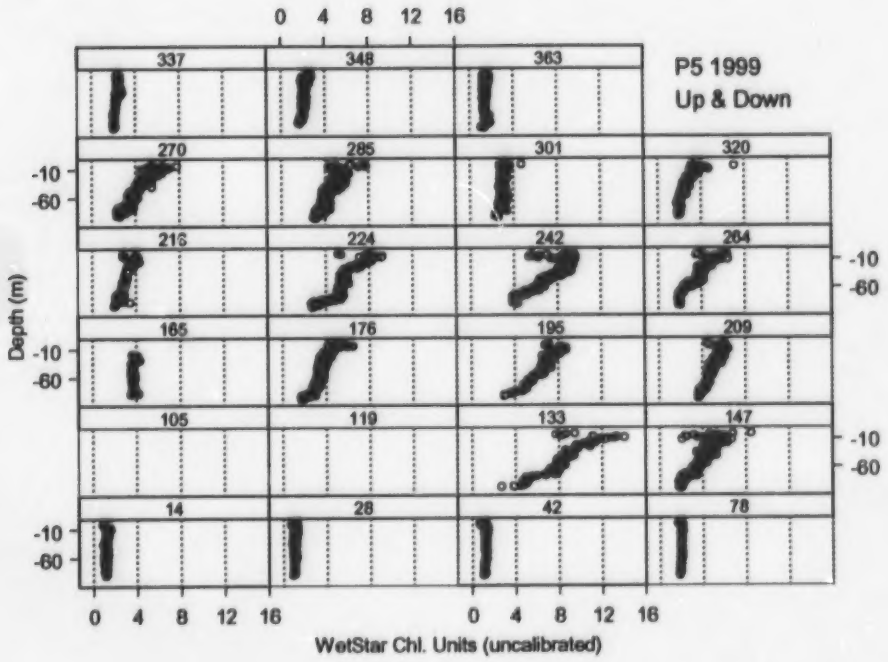

Figure 15: Depth profiles of uncalibrated WetStar Chlorophyll for each 1999 Prince 5 sample date. Numbers in the panel above each profile refer to the day of year the profile was taken.

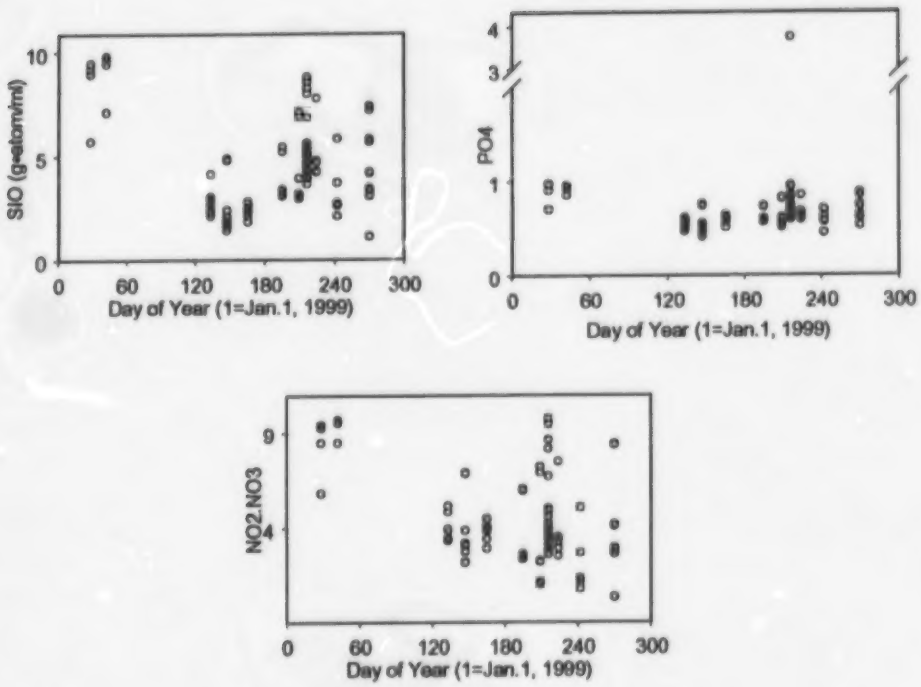

Figure 16: Annual time series of the concentration of nutrients collected from all depths at Prince 5 during 1999.

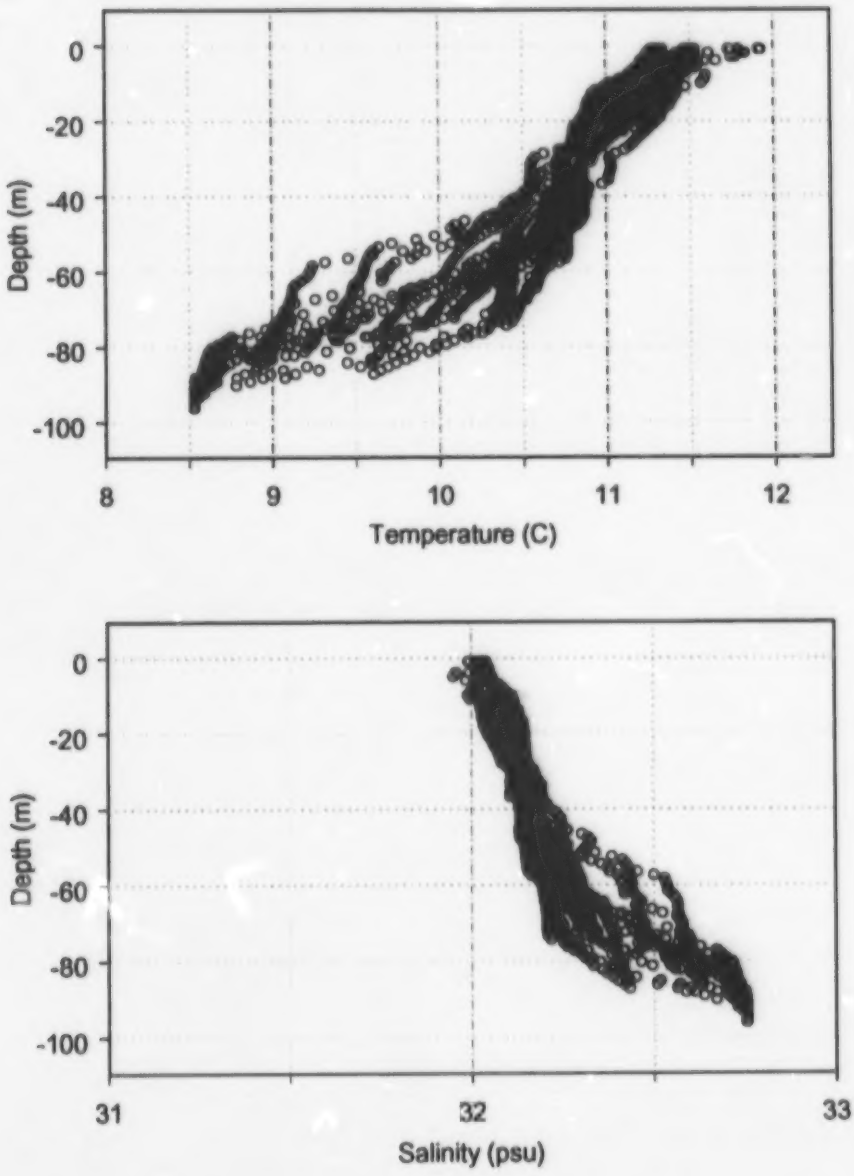

Figure 17: Composite depth profiles of temperature and salinity collected at Prince 5 on 4 August 1999 from 10:55 am to 17:56 pm.

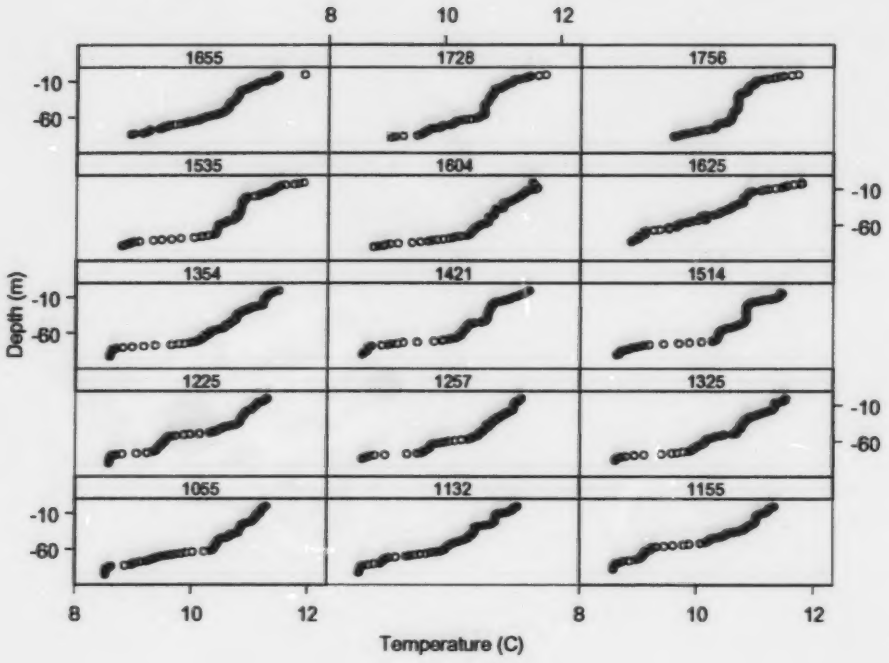

Figure 18: Temperature-depth profiles at Prince 5 on 4 August 1999 from 10:55am to 17:56pm. (Times are indicated by the numbers in the bars above each profile.)

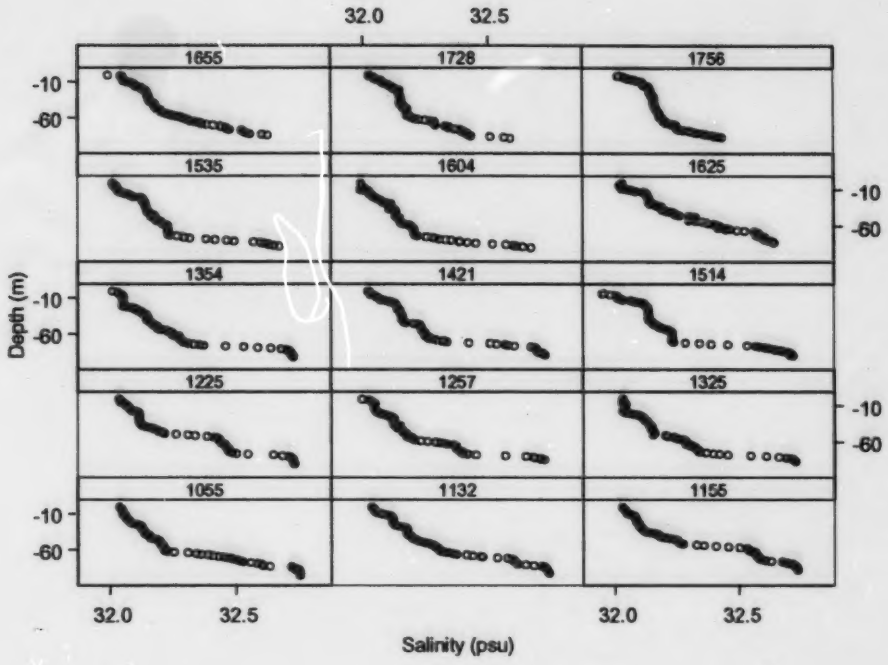

Figure 19: Salinity-depth profiles at Prince 5 on 4 August 1999 from 10:55am to 17:56pm. (Times are indicated by the numbers in the bars above each profile.)